#100

United States
Department of
Agriculture

Forest Service

Alaska
Region

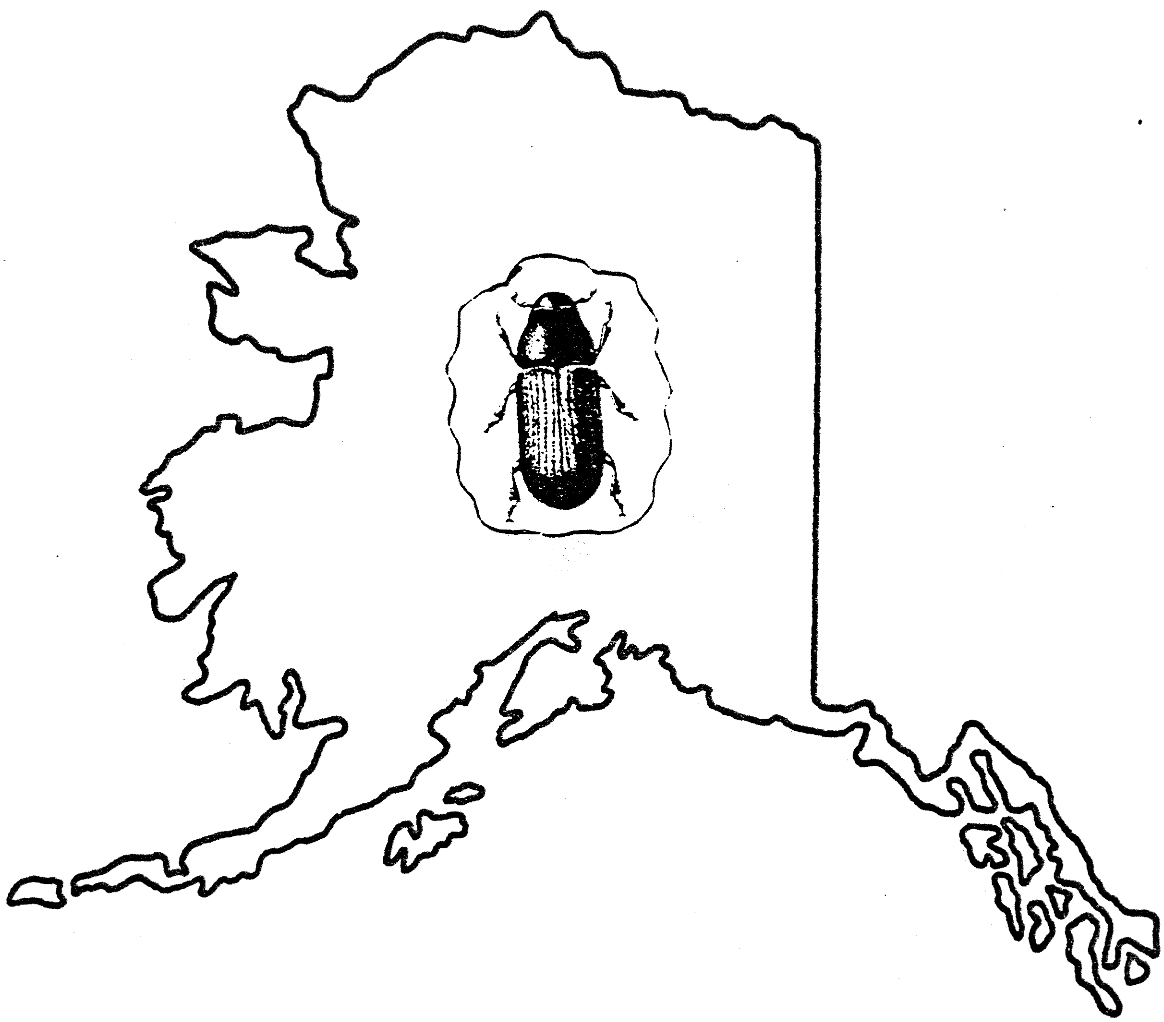
100

Forest Pest Management Report

Technical Report R-10-14

MCH Bubble Caps/Spruce Beetle

April 1987



3430

TECHNICAL REPORT R10-14

APRIL 1987

USE OF MCH BUBBLE CAPS IN PREVENTING SPRUCE BEETLE ATTACKS IN ALASKA

Prepared by: Edward H. Holsten

Edward H. Holsten, Entomologist
Forest Pest Management
Region 10, Alaska

Richard A. Werner

Richard A. Werner, Research Entomologist
Institute of Northern Forestry
PNW-INF, Fairbanks, Alaska

Approved by: James E. Eggleston

James E. Eggleston, Director
State and Private Forestry
Region 10, Alaska

Forest Pest Management
USDA Forest Service
State and Private Forestry
201 E. 9th Ave., Suite 201
Anchorage, Alaska 99501

ABSTRACT

Methylcyclohexenone (MCH) formulated in a controlled-release bubble cap was tested in 1986 at elution rates of 1, 3, and 5 mg MCH/day. The purpose of the test was to determine the efficacy of the controlled-release formulation in protecting spruce trees from attack by spruce beetle. Treatments reduced the number of attacks from 43 - 53% but differences among treatments were not significant. Treatments had no effect on mean numbers of egg galleries and progeny but did cause a reduction in egg gallery length. Bubble caps were formulated to release MCH at 16°C which coincided with spruce beetle flight threshold temperature of 14.5°C.

INTRODUCTION

The spruce beetle, Dendroctonus rufipennis, is the most destructive pest of white, Picea glauca, Lutz, P. glauca x lutzii, and Sitka, P. sitchensis, spruce in south-central Alaska (Werner et al. 1977). In 1986, infestations covered 370,000 acres of which 40,423 acres occurred on the Chugach National Forest. The infestation has continued throughout the Chugach NF for the past 14 years.

Control techniques recommended for spruce beetle suppression include: the immediate salvage of infested material in conjunction with trap trees (Gibson 1984, Hodgkinson 1985), insecticide treatments (Werner et al. 1983, 1984, 1986 a,b), and use of attractant-baited traps to reduce beetle populations.

Another technique is the use of synthetic antiaggregative pheromones to prevent attack or reduce attack density to a level below the threshold density required for the development of brood trees. Recently, a granular controlled-release formulation of methylcyclohexenone (MCH) was aerially applied to 200 acres of uninfested Douglas-fir (Pseudotsugae menziessi) and Englemann spruce (P. engelmanni) in Idaho (McGregor et al. 1984). The treatment reduced Douglas-fir beetle infestations by 94.6% and spruce beetle attacks by 55%.

For the past three years, field studies have been conducted in south-central Alaska to test the efficacy of controlled-release formulations of MCH for the protection of felled spruce trees from attack by spruce beetles (Holsten and Werner 1984, 1985 a,b). In 1983, liquid and granular controlled-release formulations of MCH were each tested at three dosages. The best granular treatment (9.2 kg/ha) reduced beetle attacks and subsequent progeny by 70 and 61% respectively, when compared to the untreated controls (Holsten and Werner 1984). A similar study conducted in 1984 (Holsten and Werner 1985a), showed no significant differences between treated and untreated trees, but did indicate that cooler spring and summer temperatures reduced the elution rate of formulated MCH to lower than expected levels. We felt the field elution rate of MCH might be doubled or tripled in order to reduce attack by spruce beetles.

In addition to the use of liquid and granular controlled-release MCH formulations, a controlled-release bubble cap device was developed at the University of British Columbia. This bubble cap is used in conjunction with traps or stapled onto the bole of windthrown or felled trees. MCH bubble caps were previously tested in Montana for the reduction of spruce beetle attacks on Engelmann spruce (Lindgren and McGregor 1986). Spruce beetle attacks were reduced 25% as compared to attacks on untreated felled Engelmann spruce.

In 1985, MCH bubble caps were applied to spruce trees felled at intervals of either 2 or 3 m near Juneau Creek on the Chugach National Forest (Holsten and Werner 1985b). There were no significant differences in beetle attacks between treated and untreated trees. This lack of protection of spruce from spruce beetle attacks was apparently due to the lower than expected release rate of the actual components in the formulated MCH. We therfore decided that membrane composition and/or thickness of the bubble caps must be changed in order to increase the elution rate.

OBJECTIVES

The main objective of the following study was to determine the efficacy of a redesigned MCH bubble cap formulated at three release rates in reducing spruce beetle attacks.

MATERIALS AND METHODS

<u>Study Site</u>: The field test was conducted in a Lutz spruce stand at Mile 34 of the Seward Highway on the Chugach National Forest (latitude $60^{o}30'$N, longitude $149^{o}45'$W). This area is composed of mature Lutz spruce mixed with Lutz, black spruce (<u>P. mariana</u>) saplings and hardwoods. Average diameter and height of the dominant and co-dominant spruce used in the study were 34.8 cm and 20.0 m, respectively. Beetle populations were increasing throughout the study area.

Treatments: The experimental design was a complete randomized experiment with three treatments and an untreated check, each replicated ten times. Forty uninfested Lutz spruce were felled and treated in early May 1986 along four north-south transects. Each tree and transect was at least 30 m from the next experimental tree and felled to allow shading to the sides and top of the bole. Air temperature was recorded hourly on a Belfort[R] hygrothermograph placed within the center of the study area.

We tested three release rates: 1, 3, and 5 mg MCH/day. Each bubble cap was formulated to release MCH at a constant rate at 16°C (vs. 20°C in previous studies) for 75 days[1/]. Bubble caps were attached, by means of a staple gun, along the upper bole of unlimbed trees at 1.5 m intervals.

Treatment Evaluation: Paired bark samples were removed from each tree during mid-August 1986. Two bark samples (232 cm^2 each) were taken from opposite sides of the bole along mid-line at 3 m, and another pair was removed at the 20 cm bole diameter. Each bark sample was evaluated for treatment efficacy as follows: (1) number of beetle attacks per m^2 of bark, (2) number of egg galleries (partial and whole) and mean egg gallery length per m^2 of bark, and (3) number and stage of beetle brood per m^2 of bark.

1/ Phero Tech Inc., Vancouver, B.C. Personal Communication. March 1986.

Analysis: Variables were subjected to a one-way analysis of variance (ANOV). Data were transformed, if necessary, to overcome variations due to zero counts which were expected to exist in the treated trees. If significant differences occurred, Duncan's Multiple Comparison Test (P=0.05) of the means was employed. Chi-square analysis was used to detect significant treatment differences with respect to numbers of eggs and pupae as the ANOV demonstrated a highly skewed distribution of the data.

RESULTS AND DISCUSSION

The three treatments significantly reduced the number of spruce beetle attacks by 43-53% (Table I). This reduction of spruce beetle attacks is substantially less than the 75% reduction demonstrated by Lindgren and McGregor (1986).

It appears that altering the bubble cap membrane provided a significant reduction in attacks. Approximate flight threshold of the spruce beetle is 14.5^{O}C and beetles had favorable flight temperatures from mid-June through July 1986 (Fig.1). Bubble caps formulated to release at 16^{O}C would affect beetle behavior earlier in the flight period than a 20^{O}C release device as used in previous studies.

MCH not only inhibits beetle attacks but appears to delay attack and subsequent gallery construction. Gallery length was significantly reduced in treated trees compared to untreated trees (Table I).

Table I. Average number per m^2 of spruce beetle attacks, galleries, progeny, and gallery length by treatment.

Treatment	No. of Trees	$\overline{X}$ No. Attacks	$\overline{X}$ No. Galleries	$\overline{X}$ No. Larvae	$\overline{X}$ No. Pupae	$\overline{X}$ No. Eggs	$\overline{X}$ Gallery Length(cm)
1 mg	10	46.8[a1]	6.5[a]	814.6[a]	44.1[a]	87.7[a]	120.7[a]
3 mg	10	56.5[a]	6.9[a]	914.6[a]	40.8[a]	207.7[a]	158.7[a]
5 mg	10	56.5[a]	5.8[a]	1211.5[a]	56.1[a]	204.5[a]	138.1[a]
Checks	10	99.0[b]	7.8[a]	1881.4[a]	64.2[a]	119.7[a]	264.3[b]

[1] Numbers in the same column followed by the same letters are not significantly different (P = 0.05) as determined by Duncan's Multiple Comparison test.

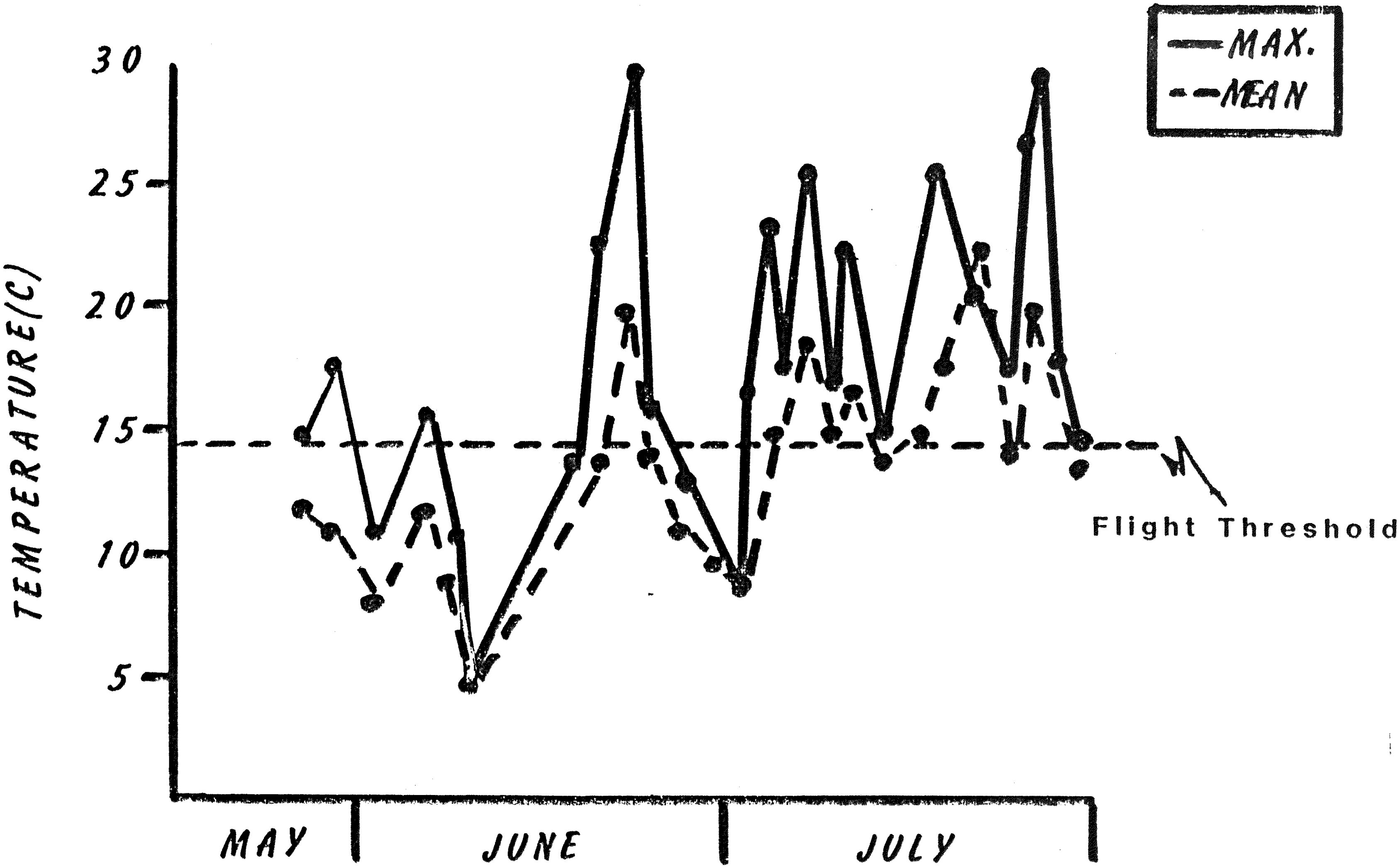


FIG. 1. TEMPERATURES FOR MILE 34, SEWARD HIGHWAY, ALASKA.

There is recent evidence[1/] that MCH may not be the sole antiaggregative pheromone involved in spruce beetle behavior. This may explain the inconsistent results obtained from our previous MCH field tests. A 95% or greater reduction in attack density is needed to effectively eliminate or reduce the susceptibility of wind thrown or felled spruce as brood material. Further identification of the antiaggregative components is required before field tests are continued.

1/ S. Lindgren, Phero Tech Inc., Vancouver, B.C. Personal Communication. October, 1986.

LITERATURE CITED

Anonymous. 1986. Forest insect and disease conditions in Alaska in 1986. USDA For. Serv., Alaska Region. 34 p

Gibson, K.E. 1984. Use of trap trees for the reduction of spruce beetle-caused mortality in old-growth Engelmann spruce stands in the Northern Region. USDA For. Serv., Northern Region, Missoula, MT., Rpt. 84-10. 11p.

Holsten, E.H. and R.A. Werner. 1984. Evaluation of methyl-cyclohexenone (MCH) in preventing or suppressing spruce beetle attacks in Alaska. USDA For. Serv., Alaska Region, Tech. Rpt. R10-6. 16p.

Holsten, E.H. and R.A. Werner. 1985a. Evaluation of controlled release formulation of methyl-cyclohexenone (MCH) in preventing spruce beetle attacks in Alaska. USDA For. Serv., State and Private Forestry, Tech. Rpt. R10-9. 9p.

Holsten,E.H. and R.A. Werner. 1985b. Evaluation of methyl-cyclohexonone (MCH) in preventing or suppressing spruce beetle attacks in Alaska. USDA For. Serv., Alaska Region, Tech. Rpt. R10-12 9p.

Hodgkinson, R.S. 1985. Use of trap trees for spruce beetle management in British Columbia, 1979-1984; A review with recommendations. B.C. Ministry of Forests, Pest Management Report No. 5. 39p.

McGregor, M.D., Furniss, M.M., Oaks, R.D., Gibson, K.E., and H.E. Meyer. 1984. MCH pheromone for preventing Douglas-fir beetle infestation in windthrown trees. Journ. of Forestry. Vol. 82(10): 613-616.

Lindgren, B.S. and M.D. McGregor. 1986. Use of MCH released from bubble cap devices to suppress spruce beetle attacks on felled spruce trees. 15p (in press).

Werner, R.A., Baker, B.H., and P.A. Rush. 1977. The spruce beetle in white spruce forests in Alaska. USDA For. Serv., PNW For. and Range Exper. Stat., Portland, OR. General Tech. Rpt. PNW-61. 13p.

Werner, R.A., Hastings, F.L., and R.D. Averill. 1983. Laboratory and field evaluation of insecticides against the spruce beetle (Coleoptera: Scolytidae) and its parasites and predators in Alaska. J. Econ. Entomol. 76(5):1144-1147.

Werner, R.A., Averill, R.D., Hastings, F.L., Hilgert, J.W., and U.E. Brady. 1984. Field evaluation of Fenitrothion, Permethrin, and Chlorpyrifos for protecting white spruce trees from spruce beetle (Coleoptera: Scolytidae) attack in Alaska. J. Econ. Entomol. Vol. 77(4):995-998.

Werner, R.A., Hastings, F.L., Holsten, E.H., and A.S. Jones. 1986a. Carbaryl and Lindane protect white spruce from attack by spruce beetles (Coleoptera: Scolytidae) for three growing seasons. J. Econ. Entomol. 79: 1121-1124.

Werner, R.A., Holsten, E.H., and Hastings, F.L. 1986b. Evaluation of pine oil for protecting white spruce from spruce beetle (Coleoptera:Scolytidae) attack. J. Entomol. Soc. Brit. Columb. 83:3-5.